Energy use, air quality, climate change and water supply issues are interrelated and must be addressed together.

Air Quality

Why is this important?

Good air quality is vital for the health of residents, nature and the economy. Human health effects of air pollution can range from lung irritation to cancer and premature death. Ecological effects include damage to crops and contamination of waters. Degradation in human and ecological health often adversely impacts economic well-being.

How are we doing?

The SCAG region includes four air basins: South Coast, Mojave Desert, Salton Sea and South Central Coast (Ventura County portion) (see Map on next page). An air basin generally has similar meteorological and geographical conditions throughout. Despite the improvements for the past three decades, almost the entire region still has not met the federal standards for ozone.[1] In addition, the most populous South Coast Air Basin with 16.5 million population has not met the federal standards for $PM_{2.5}$.

Since 1980, the region has accomplished significant improvements in its air quality particularly with respect to carbon monoxide (CO) and ozone. For example, the number of days exceeding the federal 8-hour CO standards in the South Coast Air Basin was reduced from 63 days in 1980 to zero days in 2006, and the SCAG region is now a CO attainment area. In addition, the number of days exceeding the federal 8-hour ozone standards in the South Coast Air Basin was reduced from 206 days in 1980 to 86 days in 2006. Even in the Inland Empire, emission levels have been reduced by almost half during the last decade. *Despite the significant improvements, the South Coast Air Basin still has some of the worst air quality in the nation. Specifically, the South Coast has the highest concentration of ozone and $PM_{2.5}$ in the nation. In addition, improvements to ozone and $PM_{2.5}$ have shown signs of leveling off over the past few years. Furthermore, the region and the state have faced significant challenges in developing and implementing plans to meet the attainment deadlines for ozone and $PM_{2.5}$.*

While control efforts in the past three decades gave relatively more emphasis first to carbon monoxide and then ozone, recent studies have confirmed the severe health impacts of air pollution, particularly for $PM_{2.5}$ as further discussed below and in the essay on air quality and health in this report. The enhanced understanding of health impacts has also changed the basis of assessment of air quality in the region.

Air quality trends are affected by emissions as well as meteorology (weather) and terrain. In particular, meteorology causes year-to year changes in air quality trends that can mask the impacts of emissions. However, long-term trends are closely related to the changes in emission levels.

Air Basins in the SCAG Region

$PM_{2.5}$

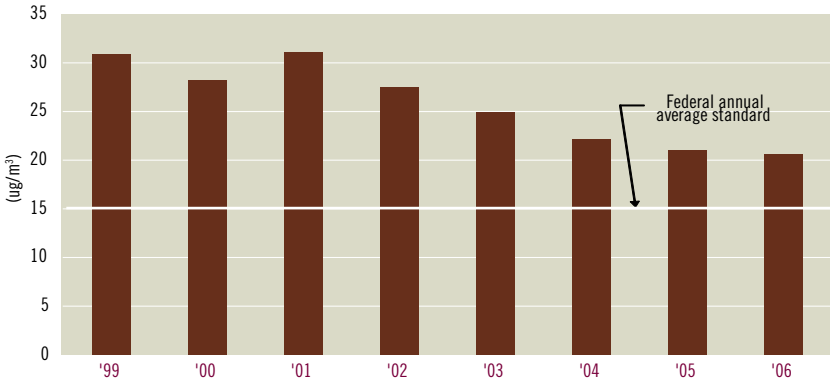
$PM_{2.5}$ is particulate matter with a diameter of 2.5 micrometers (um) or smaller. The diameter of a human hair is about 60 micrometers. $PM_{2.5}$ is a subgroup of finer particles within the classification of PM_{10}, particulate matter with a diameter of 10 micrometers (um) or smaller. Exposure to particulate matter aggravates a number of respiratory illnesses and may even cause early death. $PM_{2.5}$ poses increased health risks because it can penetrate deeper in the lung than PM_{10} and contain substances that are particularly harmful to human health. Both long-term and short-term exposure can have adverse health impacts.

Though the U.S. EPA established $PM_{2.5}$ standards in 1997, non-attainment designations for areas did not become effective until 2005. Within the SCAG region, only the South Coast Air Basin was designated as a non-attainment area with 2014 as the required attainment year. Within the state, San Joaquin Valley is the only other federally designated non-attainment area for $PM_{2.5}$. The State Implementation Plan (SIP) for $PM_{2.5}$ is due to U.S. EPA in April 2008 but was submitted earlier in fall 2007 along with the ozone SIP because many of the control strategies that reduce $PM_{2.5}$ precursor emissions are also needed to help attain the 8-hour ozone standard. State non-attainment designation for $PM_{2.5}$ is more encompassing and includes, in addition to the South Coast, the Western Mojave Desert Air Basin and Ventura County.

In 2006, the annual average $PM_{2.5}$ concentration in the South Coast Air Basin was 20.6 ug/m^3, a slight decrease from that in the previous year (21ug/m^3) but continuing to significantly exceed the federal standards of 15 ug/m^3 (Figure 79). Specifically, 11 of the 18 monitoring stations in the basin showed exceedance, with the Mira Loma area in Riverside County having the highest concentration. Since 2004, improvement to $PM_{2.5}$ has shown signs of leveling off.

Figure 79

$PM_{2.5}$ Pollution in the South Coast Air Basin
(Annual Average Concentration)



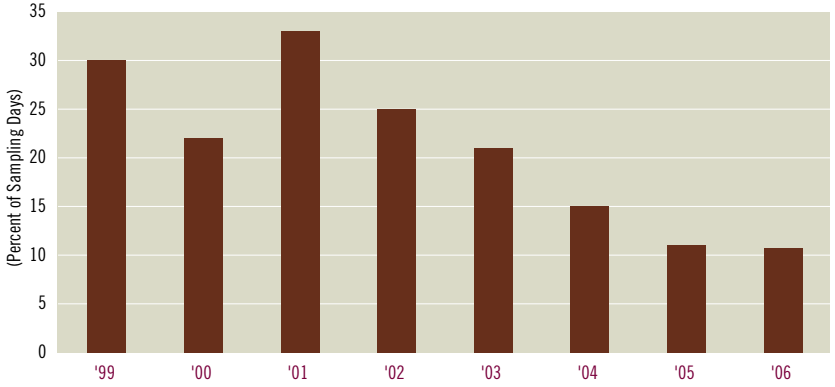
Source: South Coast Air Quality Management District

Effective December 17, 2006, the U.S. EPA revised the federal 24-hour $PM_{2.5}$ standard to be much more stringent, from 65 ug/m³ to 35 ug/m³. *In 2006, the South Coast Air Basin exceeded the (new) federal 24-hour standard for $PM_{2.5}$ on 11 percent of sampling days, though it did not have any exceedance as to the federal 24-hour standard for PM_{10} (Figure 80).* This is partly because $PM_{2.5}$ particles being smaller than PM_{10} particles are more difficult to control. It is expected that the U.S. EPA will designate the new 24-hour $PM_{2.5}$ non-attainment areas by November 2009 with the attainment year by approximately 2020.

Figure 80

$PM_{2.5}$ Pollution in the South Coast Air Basin

(Percent of Sampling Days Exceeding the New Federal 24-hour Standard of 35 ug/m³)



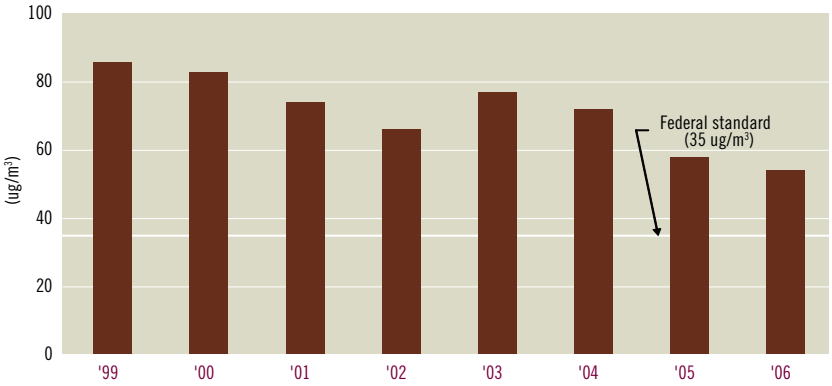
Source: South Coast Air Quality Management District

In 2006, the maximum 24-hour $PM_{2.5}$ concentration in the South Coast Air Basin at 54 ug/m³ also well exceeded the new federal standard of 35 ug/m³. Since 1999, there has been generally a downward trend in reducing the maximum 24-hour $PM_{2.5}$ concentration in the South Coast Air Basin (Figure 81).

Figure 81

$PM_{2.5}$ Pollution in the South Coast Air Basin

(98 Percentile of 24-hour Concentration)



Source: South Coast Air Quality Management District

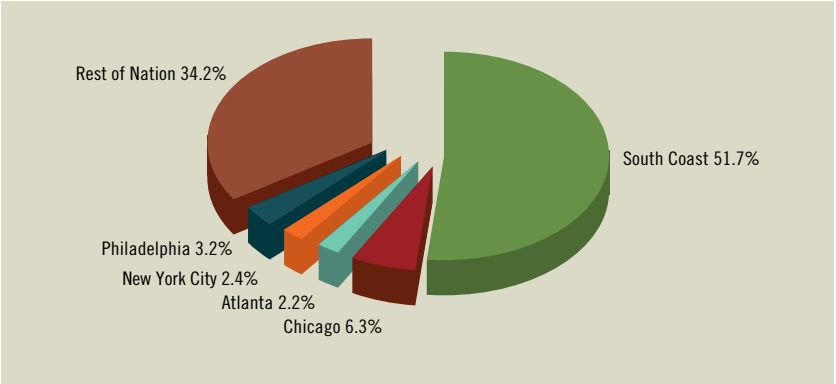
On an annual basis, directly emitted $PM_{2.5}$ emissions contribute approximately 40 percent of the ambient $PM_{2.5}$ in the South Coast Air Basin, while 60 percent is formed secondarily. Among the directly emitted $PM_{2.5}$ emissions, about 55 percent are from areawide sources, while 33

percent are from mobile sources and another 12 percent are from stationary sources. Attainment of the federal health-based $PM_{2.5}$ standard would demand significant reductions in $PM_{2.5}$ components within the next seven years. The $PM_{2.5}$ attainment strategy focused primarily on reductions of NO_X, SO_X, directly emitted $PM_{2.5}$, supplemented with additional VOC reductions that can be feasibly achieved by 2014. NO_X and SO_X emissions are both products of fuel combustion.

$PM_{2.5}$ is responsible for most of the serious health effects known from exposure to ambient air pollutants. It should be noted that the South Coast Air Basin has a disproportionate share of $PM_{2.5}$ exposure and hence suffered disproportionate impacts. Specifically, the South Coast has almost 52 percent share of the nation in population-weighted exposures to $PM_{2.5}$ above the national annual average standard (Figure 82). Accordingly, residents in the South Coast suffer extraordinary health impacts including an estimated 5,400 premature deaths annually as contained in Figure 83.[2] In comparison, highway accidents resulted in 1,881 deaths and there were 1,460 homicides in the region in 2006.

Figure 82

$PM_{2.5}$ Pollution
South Coast Air Basin Disproportionate Exposure



** Population-weighted exposures above the national annual average standard based on 2000-02 AIRS data*
Source: South Coast Air Quality Management District

Exposure to $PM_{2.5}$ pollution can shorten life by about 14 years for people who die prematurely. In addition, there is a 15 percent increase in the risk of overall premature death for each 10 ug/m^3 increase in $PM_{2.5}$ annual concentration. The groups most vulnerable to the $PM_{2.5}$ pollutant include infants and children, the elderly, and those with pre-existing heart or lung disease.

Figure 83

$PM_{2.5}$ Pollution – Annual Health Impacts
South Coast Air Basin

- 5,400 premature deaths
- 140,000 children with asthma and lower respiratory symptoms
- 980,000 lost work days
- 80% of emissions are under the state or federal jurisdictions and not within local control

Source: California Air Resources Board

On the other hand, about 80 percent of the emission sources for $PM_{2.5}$ are within the jurisdiction of state ARB (regarding e.g., on-road/off-road vehicles, motor vehicle fuels, and consumer products) or federal EPA (regarding e.g., vehicle emission standard, airplanes, ships and trains). Specifically, to achieve $PM_{2.5}$ attainment in 2014, about 56 percent of the emission reductions needed is within the state ARB jurisdiction while another 24 percent are within the federal EPA jurisdiction. *To have any reasonable expectation of meeting the $PM_{2.5}$ attainment deadline by 2014, the pace of improvement for $PM_{2.5}$ must accelerate under the federal and state jurisdictions.*

PM_{10}

Three air basins in the region have been designated as non-attainment areas for PM_{10}: the South Coast, Salton Sea and Mojave Desert. It should be noted that, effective December 17, 2006, the U.S. EPA revoked the PM_{10} annual standard but retained the 24-hour standard.

In 2006, the number of days exceeding the federal 24-hour standard (150 ug/m3) for PM_{10} increased slightly from 0 to 2.8 days in the Mojave Desert Air Basin, and from 8.5 days to 12.5 days in the Salton Sea Air Basin (Figure 84). The number of days with an unhealthy level of PM_{10} describes the chronic extent of PM_{10} pollution. *Between 2004 and 2006, the South Coast Air Basin did not experience any exceedance based on the federal 24-hour standard.*

Figure 84

PM_{10} Pollution
(Days Exceeding Federal 24-hour Standard)

Air Basin	'04	'05	'06
Mojave Desert	1.9	0	2.8
Salton Sea	7.8	8.5	12.5
South Coast	0	0	0

Source: California Air Resources Board

California state standards for PM_{10} are much more stringent than federal standards due to greater consideration given to the potential health impacts. Specifically, the state annual average standard for PM_{10} of 20 ug/m^3 is only 40 percent of the (revoked) federal standard of 50 ug/m^3. In 2006, both the Salton Sea and South Coast continued to significantly exceed the state annual average standards. In addition, the state 24-hour standard for PM_{10} of 50 ug/m^3 is only a third of the federal standard of 150 ug/m^3. In 2006, both the Salton Sea and South Coat air basins exceeded the state PM_{10} 24-hour standard on 241 days.[3]

Ozone

Beginning in June 2005, the national 1-hour ozone standard was revoked and replaced by a new 8-hour ozone standard that is more health protective. The new ozone standard is more stringent than the old standard but allows longer timeframe for attainment until 2023 for the South Coast. Currently, all four air basins in the region are designated as non-attainment areas for 8-hour ozone.[4]

Ozone is a colorless and poisonous gas. Ground level ozone is a major component of urban and regional smog. Ozone is a strong irritant, which can reduce lung function and aggravate asthma as well as lung disease. Repeated short-term ozone exposure may harm children's developing lungs and lead to reduced lung function in adulthood. In adults, ozone exposure may accelerate the natural decline in lung function as part of the normal aging process.

In 2006, ozone pollution worsened slightly in the South Coast Air Basin and Ventura County but improved in the Mojave Desert and Salton Sea air basins. In the most populous and polluted South Coast Air Basin, the number of days exceeding the federal 8-hour ozone standard increased slightly from 84 days in 2005 to 86 days in 2006, still the second lowest since 1976 (Figure 85). However, since 1998 ozone improvements have shown signs of leveling off.

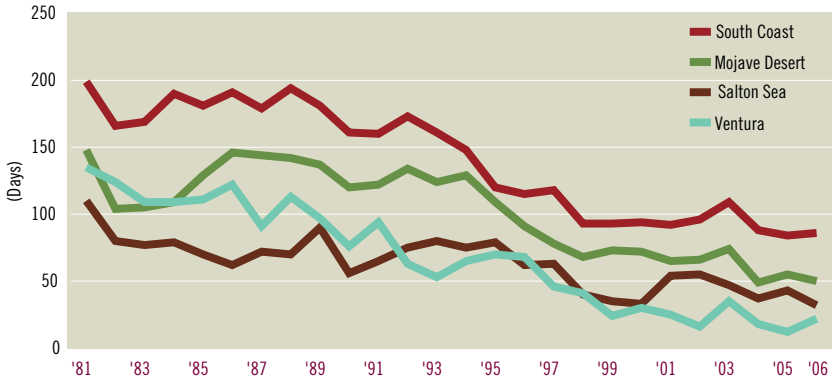
Between 2005 and 2006, the maximum 8-hour ozone concentration in the South Coast Air Basin decreased very slightly from 0.145 ppm (parts per million parts of air) to 0.142 ppm, about half of the 1985 level.[5] The number of days for health advisories also decreased from 11 to 10 days between 2005 and 2006.[6]

Between 2005 and 2006, Ventura County also increased the number of days exceeding the federal 8-hour standard, from 12 to 22 days. However, during the same period, both the Mojave Desert and the Salton Sea air basins experienced reductions in the number of days exceeding the federal 8-hour standard, from 55 to 50 days and 43 to 32 days

respectively. *Within the region, the Central San Bernardino Mountain area surpassed the federal 8-hour ozone standard for a total of 59 days in 2006 followed by the Perris Valley (53 days) and Banning Airport area (44 days) both in Riverside County, and Santa Clarita Valley (40 days).*

Figure 85

Ozone Pollution in Non-attainment Air Basins
(Number of Days Exceeding Federal Eight-Hour Standard)



** Ventura County is part of the South Central Coast Air Basin*
Source: California Air Resources Board and South Coast Air Quality Management District

Emissions of ozone precursors including NOx and ROG in the South Coast Air Basin are generally following a downward trend. For example, total emissions of NO_X were reduced from over 1,700 tons/day in 1975 to about 950 tons/day in 2005. This is primarily due to the reductions from on-road mobile sources as well as stationary sources. The reductions from on-road mobile sources were due to the more stringent vehicle emission standards and as newer, less-polluting vehicles become a larger share of the fleet. The reductions of NO_X emissions from stationary sources (e.g., electric utilities) are primarily due to increased use of natural gas as the principal fuel for power plants, and control rules that limit NO_X emissions.

In 2005, more than 90 percent of the total NO_X emissions in the South Coast Air Basin came from mobile sources. For example, heavy duty trucks were responsible for 320 tons/day of NO_X, a third of the total NO_X emissions in the South Coast Air Basin and more than half of the NO_X emissions from on-road mobile sources. As to "other mobile sources", major NO_X contributors are off-road combustion equipment, ships and trains. The NO_X emissions from off-road combustion equipment have been decreasing and offset the increases from ships.

Despite the large reductions of NO_X for the past three decades, significant reductions above and beyond those already achieved are still needed to meet the federal ozone standards by 2024 and $PM_{2.5}$ standards by 2014. Specifically, NO_X reductions primarily based on mobile source control strategies are essential for both ozone and $PM_{2.5}$ attainment.

Carbon Monoxide

In December 2002, the South Coast Air Basin met federal attainment standards for CO (with no violation in 2001 and the one day allowable exceeding the federal standard in 2002). *The basin continued to have no violations for CO from 2003 to 2006.* During the past two decades, peak 8-hour CO levels in the South Coast Air Basin decreased from 28 ppm in 1985 to 6.4 ppm in 2006 (in south central Los Angeles County).[7]

On June 11, 2007, the U.S. EPA redesignated the South Coast Air Basin as an attainment area for CO along with the maintenance plan. Other basins in the region were redesignated as attainment areas earlier. Reductions from motor vehicle control programs are expected to continue the downward trend in ambient CO concentrations.

Water Resources

Total Water Use

Why is this important?

Water is essential to human life. It is one of the most precious resources in Southern California. With the continuing increase of population in the region, ensuring reliable water resources to meet demand and maintaining water quality are vital goals for all of Southern California. In addition, how water is used would also impact the health and sustainability of the regional ecosystem.

How are we doing?

For more than 100 years, Southern California has had to import water to support its ever increasing population. The region is an arid to semi-arid environment with low annual precipitation. *Currently, imported water accounts for about 70 to 75 percent of the regional water supply.* The remaining 25 to 30 percent comes from local surface and ground water and from reclaimed water sources.[8]

Imported water includes water from the Colorado River via the Colorado River Aqueduct, the State Water Project via the California Aqueduct, and the eastern Owens Valley/Mono Basin in the Sierra Nevada via the Los Angeles Aqueduct. *It is important to note that available water from all three imported sources may be reduced in the future as other users and uses place greater demands on these sources.* For example, environmental and water quality needs in the Delta and Owens River/Mono Basin systems affect import water supply quantity, quality and reliability. In addition, the Colorado River basin has experienced a five-year drought that is unprecedented in recorded history, while total water demand in its basin continues to rise because of population and economic growth. The Colorado River Water that could experience further sustained droughts is perhaps the most critical and uncertain element of the water resource planning in Southern California.

In addition, the region also needs to assess and plan for impacts of global climate change (as further discussed in the Energy Section), as well as the cost of replacing aging infrastructure. *Some of the most significant impacts from global climate change will be on water resources, impacts that are of special concern to the SCAG region where water scarcity and quality are already of great concern.*

Within the SCAG region, the Metropolitan Water District (MWD) is the largest urban water supplier. Its service area includes about 15.4 million residents in the region (Figure 86). In recent years, MWD has provided about half of the municipal, industrial and agricultural water used in its service area.

Figure 86

Population within Water District Service Area

	MWD	Non-MWD
Imperial	0.0%	100.0%
Los Angeles	91.6%	8.4%
Orange	100.0%	0.0%
Riverside	72.3%	27.7%
San Bernardino	40.9%	59.1%
Ventura	72.6%	27.4%
REGION	84.4%	15.6%

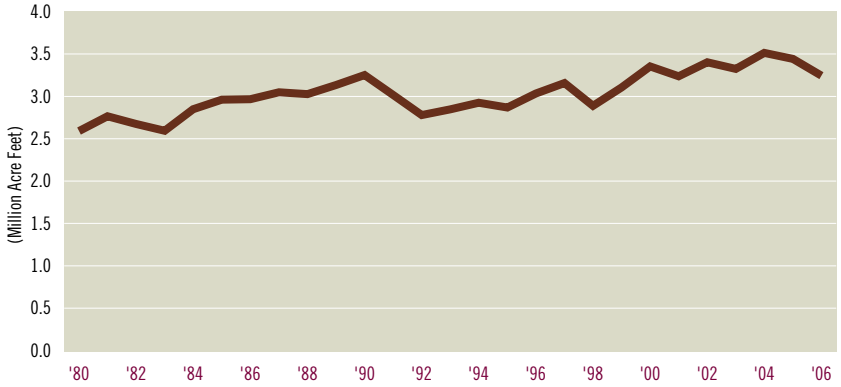
Source: Metropolitan Water District

In 2006, total water consumption within the MWD service area in the SCAG region was about 3.24 million acre-feet, a 6 percent decrease from 2005. The 2006 level was almost the same as that in 1990 (a dry year), despite an increase of almost 3 million (23 percent) residents (Figure 87). Total water consumption did not experience significant increases for several years in the mid-1990s due to the recession, wet weather, conservation efforts, and lingering drought impacts. Of total consumption, only 6.8 percent was for agricultural purposes and the rest was for urban (municipal and industrial) uses.

Figure 87

Total Water Consumption*

(Metropolitan Water District Service Area)



**Within the SCAG region. Total water consumption includes municipal/industrial and agricultural uses.*
***One acre foot equals 325,851 gallons.*
Source: Metropolitan Water District

In recent years, the region has developed an array of local projects to complement imported water supplies. They include, for example, surface water storage, groundwater storage and conjunctive use, conservation, water recycling, brackish water desalination, water transfer and storage, and infrastructure enhancements. Within the MWD service area, water conservation programs are estimated to conserve about

700,000 acre-feet of water in 2006, almost triple the 1990 level at 250,000 acre-feet. New water supply targets for Southern California through 2025 include 1.1 million acre-feet for conservation.[9] In addition, water recycling, groundwater recovery and seawater desalination are integral and growing assets in the region's diverse resource portfolio and help bring greater water supply reliability to Southern California. For example, Orange County Water District's Groundwater Replenishment System, which takes highly treated sewer water that is currently released into the ocean and purifies it, is the largest water purification project of its kind.[10]

Per Capita Urban Water Use

Why is this important?

Water consumption per capita is important when looking at a city or county's growth projections in order to maintain a safe yield per person and sustain community well-being.

How are we doing?

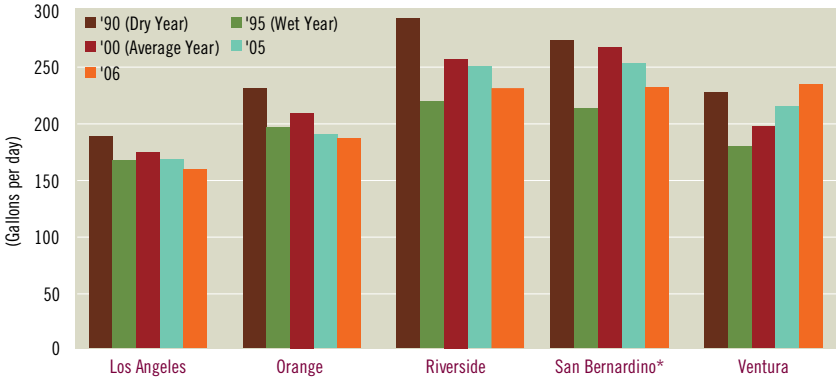
Urban water use includes residential, commercial, industrial, fire fighting and other uses. Hence, per capita urban water use consists of more than the amount of water used directly by an individual. Since 1991, per capita urban water use has generally been below the pre-drought levels. While 1990 was a dry year, 1995 was a wet year and 2000 represented an average year. In 2006, per capita urban water use declined from the 2000 level in each county in the region except for Ventura County (Figure 88).

An important factor contributing to the overall decline in per capita urban water consumption is the development of various conservation programs and practices. These include retrofitting with water efficient technology for showerheads and toilets and changing landscaping practices toward drought-tolerant plants. In addition, implementation of new water rate structures has helped suppress growth in per capita water demand.

Figure 88

Per Capita Urban Water Consumption

(Metropolitan Water District Service Area)



*San Bernardino's portion includes only 41% of the County's total population, significantly less than other counties.
Source: Metropolitan Water District

In Southern California, much of the variation in per capita water use among counties can be attributed to climate differences. Within the region, the Inland Empire counties continued to maintain higher per capita urban water consumption rates than coastal counties except for Ventura. For example, in 2006, per capita urban water consumption per day in San Bernardino and Riverside counties was 231 and 232 gallons respectively in contrast to 186 gallons in Orange County and 159 gallons in Los Angeles County. This partly reflects higher landscape water use due to warmer and dryer climate conditions. In addition, a single family unit has higher per capita water use than a multi-family unit. The Inland Empire and Ventura County have higher share (65 percent and

64 percent respectively) of detached single-family residential units than Los Angeles County (49 percent) or Orange County (51 percent).

Water Quality

Why is this important?

Good water quality is important to the well-being of human health, aquatic and terrestrial species, and the economy. The water quality of freshwater streams is affected by human activities and land use practices (such as land clearing and urbanization). Runoff from streams and rainfall flows into the ocean and impacts coastal water quality.

How are we doing?

The SCAG region straddles five Water Quality Control Board (WQCB) regions in the state: Los Angeles, Colorado River Basin, Santa Ana, San Diego and Lahontan. The Los Angeles Region encompasses all the coastal watersheds of Los Angeles and Ventura counties, along with portions of Kern and Santa Barbara counties. The Colorado River Basin Region includes all of Imperial County and portions of San Bernardino, Riverside, and San Diego counties. It covers California's most arid area. Despite its dry climate, the Region contains two water bodies of state and national significance: the Colorado River and the Salton Sea. The Santa Ana Region extends from the San Bernardino and San Gabriel mountains in the north and east to Newport Bay along the coast. The San Diego Region includes southern Orange County and stretches along 85 miles of scenic coastline from Laguna Beach to the Mexican Border and extends 50 miles inland to the crest of the coastal mountain range. Finally, the Lahontan Region includes portions of northern Los Angeles County and western San Bernardino County, and extends further north including the Sierra Nevada along the eastern border of California.

Urbanization is one of the important factors affecting water quality. Urban water runoff from roads and parking lots contain high level of contaminants which can flow directly into surface waters.[11] The pollutant loads in stormwater generally increase along with urbanization. Runoff and other problems are exacerbated by aging infrastructure. The general quality of groundwater in the region has been degraded as a result of land uses and water management practices. The coastal waters are impacted by, for example, wastewater discharges and non-point source runoff. Section 303(d) of the Clean Water Act requires the California State Water Resources Control Board to list impaired water bodies in the state and determine total maximum daily loads (TMDLs) of pollutants that are contributing excessively to these impaired waters.

Between 2002 and 2006, water quality improvements showed mixed results. While the Los Angeles and Lahontan WQCB regions saw significant improvements, water quality in the San Diego WQCB region deteriorated. The Colorado and Santa Ana WQCB regions generally maintained their water quality levels. The improvement in the Los Angeles WQCB region was due mostly to the reduction of impaired coastal shorelines as well as rivers/streams. San Diego WQCB region experienced an increase in impaired rivers/streams and bays and harbors. Impairedment of beneficial uses often occur during long period of time and can require years to correct. In recent years, watershed planning efforts have become a more prevalent means of protecting water resources.

Beach Closure

Why is this important?

When the ocean waters off a beach contain high concentrations of certain bacteria, they become unsafe for swimming and other recreational uses. In 1999, the California Department of Health began monitoring

all beaches which have more than 50,000 annual visitors and have outflows from storm drains, rivers, or creeks. Closures or advisories are issued for beaches that fail to meet the state's standards for various sources of bacterial pollution.

How are we doing?[12]

Between 2005 and 2006, the total number of beach closing/advisory days declined from 3,576 to 3,215 among beaches monitored in the region (Figure 89). However, they were greater than 2004 levels (2,860 days). The decrease of 10.1 percent of beach closing/advisory days in the region was less than that at the state level during the same period, from 5,496 to 4,644, or 16 percent.

In 2006, Los Angeles County experienced 2,072 beach closing/advisory days, following by Orange (975 beach closing/advisory days), San Diego (714 beach closing/advisory days), Santa Barbara (285 beach closing/ advisory days), and Ventura (168 beach closing/advisory days) counties. Polluted urban stormwater runoff continues to be the largest source of pollution and the predominant cause across the state.

Between 2005 and 2006, the number of beach closing/advisory days in Los Angeles County decreased slightly from 2,213 to 2,072, a 6 percent decrease following the 51 percent increase during the previous period. About 95 percent of total beach closing/advisory days in the county in 2006 were due to elevated bacterial levels from unknown sources of contamination, and 3 percent were due to known sewage spills.

Orange County experienced a 5 percent increase from 929 to 975 beach closing/advisory days between 2005 and 2006, after a 33 percent decrease during the previous period. Similar to conditions in Los Angeles County, 91 percent of total beach closing/advisory days in Orange County were due to elevated bacterial levels from unknown sources. Ventura County also experienced a significant drop of 61 percent from 434 to 168 beach closing/advisory days between 2005 and 2006, after a 4 percent reduction during the previous period.

Figure 89

Total Number of Beach Closing/Advisory Days

	'04	'05	'06
Los Angeles	1,469	2,213	2,072
Orange	939	929	975
Ventura	452	434	168
REGION	2,860	3,576	3,215
Rest of California	1,125	1,920	1,429
California	3,985	5,496	4,644

Source: Natural Resources Defense Council

Solid Waste

Why is this important?

Disposing of waste in landfills is not only costly but, if not treated properly, could have dire impacts on the ecosystem and human health. For example, decomposition of waste in landfills releases methane into the atmosphere, a significant contributor to global warming. Hence, a sustainable society should minimize the amount of waste sent to landfills by reducing, recycling or reusing the waste generated as much as possible.

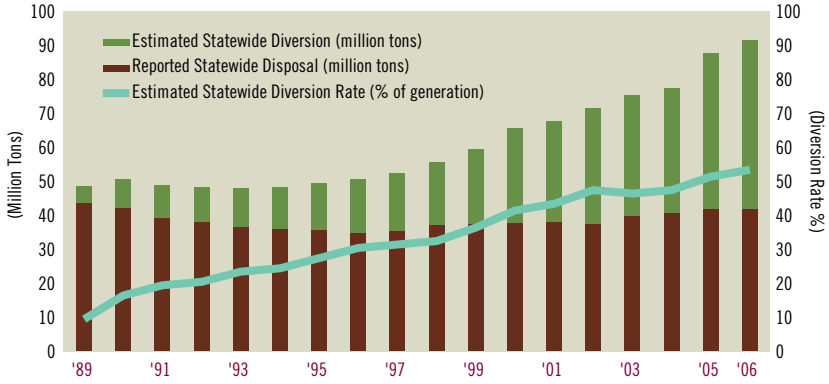
How are we doing?

The 1989 California Integrated Waste Management Act set the goal of 50 percent diversion of each city and county's waste from landfill disposal by the year 2000. In 2006, only about 40 percent of the cities in the region met the 50 percent diversion goal. Diversion measures include waste prevented, waste re-used, waste recycled or waste composted.

Waste diversion programs such as curbside recycling pickups, green-waste collection, and municipal composting have steadily increased the diversion rate. *At the statewide level, the diversion rate – the share of amount diverted out of the total waste generated - increased from 10 percent in 1989 to 54 percent in 2006 (Figure 90).*[13] Hence among the 92 million tons of waste generated in California in 2006, over 50 million tons were diverted. Among the total waste generated, about 30 percent was organic matter, 22 percent was construction and demolition materials and 21 percent was paper.[14]

Figure 90

Estimated Statewide Waste Tonnages and Rates

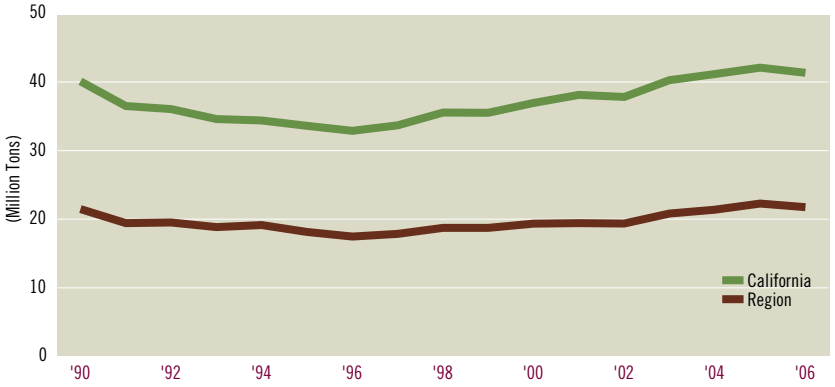


Source: California Integrated Waste Management Board

In 2006, the total amount of waste disposed to landfills in the region reached 21.8 million tons, a slight decrease of 0.5 million ton from 2005 (Figure 91). During the 1990s, waste sent to landfills in the region declined for several years, however, it has generally increased gradually since 1996. This is similar to the trend at the state level. Many landfills in the region are running out of capacity while environmental concerns make building new landfills or expanding existing landfills increasingly difficult.

Figure 91

Solid Waste Disposal at Landfills
(Million Tons)

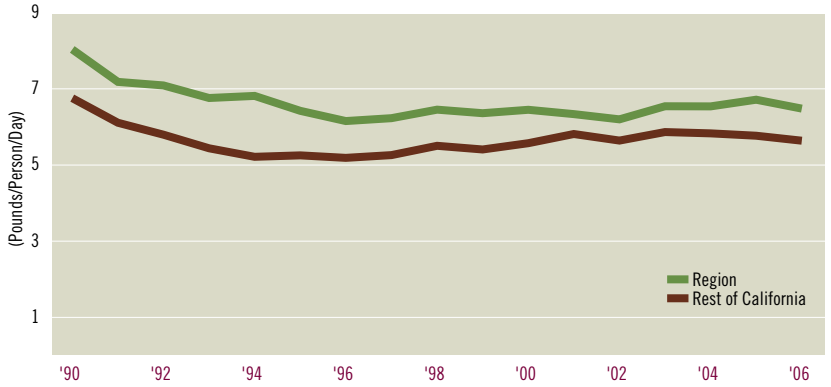


Source: California Integrated Waste Management Board

Since the passage of the Waste Management Act in 1989, the region began to make progress in reducing the amount sent to landfills on a per capita basis. In 1990, the region disposed about 8 pounds of solid waste per capita per day into the landfills, higher than that of the rest of the state of 6.8 pounds per capita per day. Various measures to implement the Act had reduced the per capita disposal rate in the region continuously to just over 6 pounds per day (or almost 25 percent) in 1996, the lowest level since 1990. Since 1996, per capita disposal rates fluctuated somewhat and began to increase after 2002 to about 6.5 pounds per day in 2006 (Figure 92).

Figure 92

Solid Waste Disposal in Landfills
(Pounds/Person/Day)



**Including residential and non-residential waste disposal*
Source: California Integrated Waste Management Board

Energy

Why is this important?

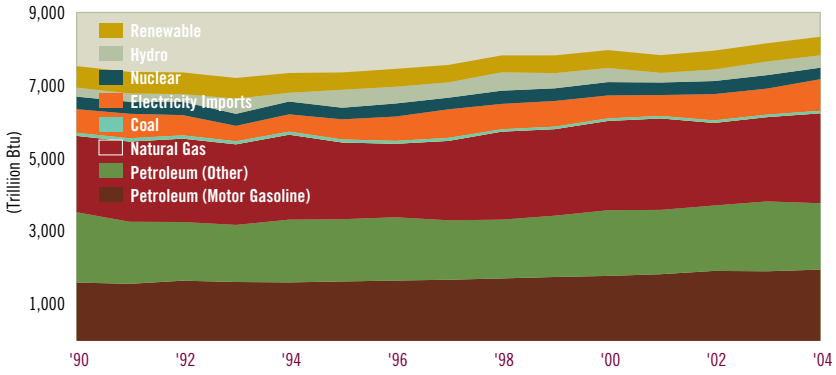
Energy is a critical input for production processes of the regional and national economy. In addition, it is essential for everyday life. Reliance on fossil fuels contributes significantly to regional air pollution and global climate change that would result in adverse impacts on many ecological systems, human health as well as the economy. Furthermore, strong dependence of foreign imports greatly reduces the reliability and security of this vital resource.

How are we doing?

Energy use in California is predominantly fossil fuel based (i.e. petroleum, natural gas and coal), accounting for about 86 percent of the total consumption (Figure 93). In addition, California obtains nearly two-thirds of its energy from outside its borders, including 63 percent of petroleum, 85 percent of natural gas and 22 percent of electricity uses (Figure 94).

Figure 93

California Energy Consumption Estimates by Source

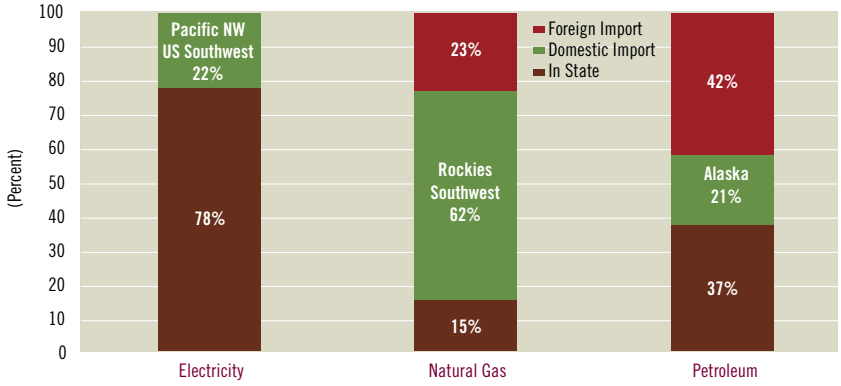


Source: Energy Information Administration, State Energy Data 2004

Based on the recent statewide inventory, petroleum accounted for about 45 percent of the total energy use, natural gas 30 percent and coal just below 1 percent.15 In addition, imported electricity (10 percent of the total energy use) was produced mainly by coal or natural gas. Other sources of energy include renewable (6.1 percent), nuclear (3.8 percent) and hydroelectric power (4.1 percent). As to the energy consumption by sectors in California, transportation sector is the largest user of 39 percent, followed by industrial sector of 24 percent. Commercial and residential sectors each used about 18.5 percent. For major energy sources such as petroleum and natural gas, the SCAG region accounts for about 45 percent of the total state use and is expected to have similar consumption patterns to that of the state in the shares of different energy sources.

Figure 94

California's Major Sources of Energy, 2006



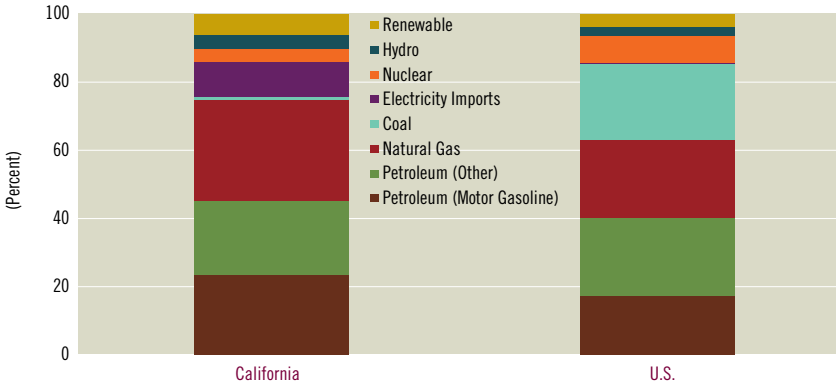
** Natural gas and petroleum data are for 2005*
Source: California Energy Commission

At the national level, 86 percent of the total energy consumption is fossil-fuel based, the same proportion as that in California. However, compared with California, the nation relies much more on coal (22

percent vs. 0.8 percent) and less on natural gas (23 percent vs. 30 percent) and petroleum (40 percent vs. 45 percent) than California (Figure 95). In addition, within the non-fossil fuels, the nation relies more on nuclear (8.2 percent) than California (3.8 percent). California surpassed the national average in the use of renewable energy (6.1 percent vs. 3.6 percent).

Figure 95

Energy Consumption by Source, 2004



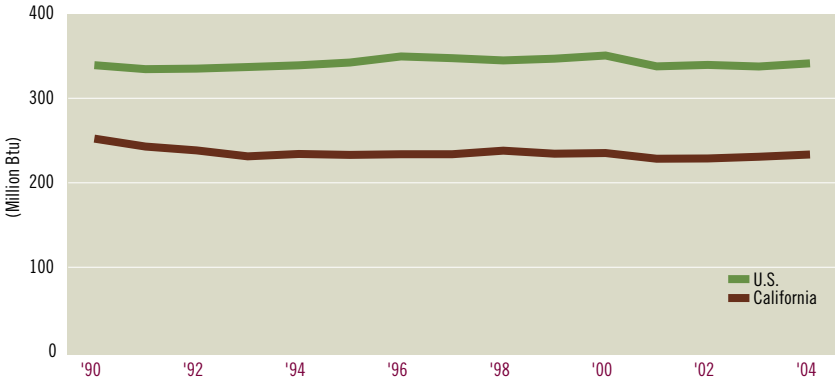
Source: Energy Information Administration

Energy use to support the national economy has become more efficient for the past few decades. For example, between 1970 and 2006, energy use per dollar of real Gross Domestic Product (GDP) was reduced by half.[16] The reductions were due to efficiency improvements and structural changes in the economy to become more service-oriented.

When compared to the U.S., California uses less energy on a per capita basis. *Since 1993, California has consistently been at least 30 percent below the national average in per capita energy consumption (Figure 96). Among all states in the nation, California ranked 3rd lowest in per capita energy consumption, following Rhode Island and New York.* Difference in climate and types of industry contributes to the lower energy consumption per capita in California as compared to the U.S. as a whole. Other factors include the higher energy efficiency appliance and building standards, and demand side management programs implemented in California. For example, energy-intensive manufacturing represents approximately 10 percent of the total economic output in California, compared to 22 percent for the U.S. In addition, when comparing within the same industry categories, California also uses less energy for a given level of output due to a more energy efficient production.

Figure 96

Per Capita Energy Consumption
(Million Btu)



Source: Energy Information Adminstration and Bureau of Economic Analysis

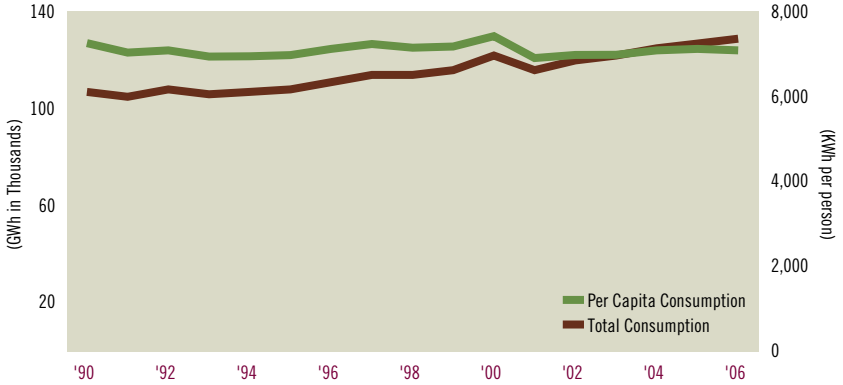
Electricity Consumption

In 2006, the SCAG region consumed approximately 129,000 gigawatt–hours (GWh) of electricity, or 7,095 kilowatt-hours (kWh) per person. In the region, electricity consumption increased 15 percent during the 1990s. Total consumption declined in 2001 after the electricity crisis but since then has been increasing about 1.3 percent per year, roughly

keeping pace with the population growth. Hence per capita electricity consumption in the region is projected to remain relatively constant over the next 10 years, at about 7,100 kWh per person, somewhat below the state average of 7,500 kWh per person (Figure 97).

Figure 97

Electricity Consumption



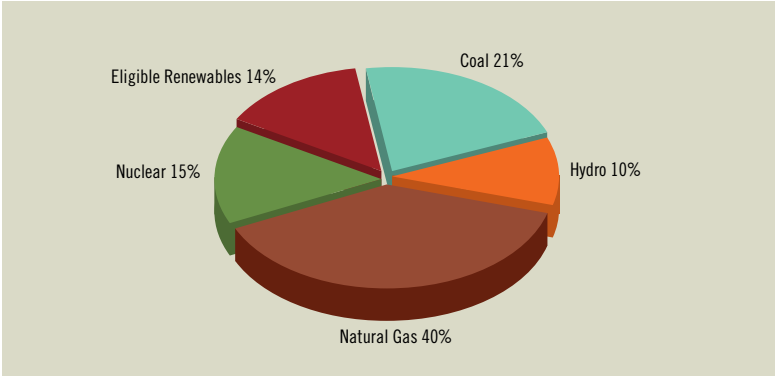
Source: California Energy Commission

In 2006, fossil fuels accounted for 61 percent of the total sources for electricity generation in Southern California, including natural gas (40 percent) and coal (21 percent), while renewable accounted for 14 percent (Figure 98). Both Southern California Edison and Los Angeles Department of Water and Power (LADWP) are required to reach 20 percent using renewable energy. Between 2005 and 2006, the share of natural gas increased by 6 percentage points while the share of nuclear power decreased by 5 percentage points.

In the region, commercial was the largest user (39 percent) of electricity followed by residential (31 percent) and industrial (19 percent).

Figure 98

Electricity Generation by Source, 2006



**Based on the combined mix of Southern California Edison and Los Angeles DWP*
Source: California Energy Commission, Southern California Edison, Los Angeles Department of Water and Power, July 2007

Natural Gas Consumption

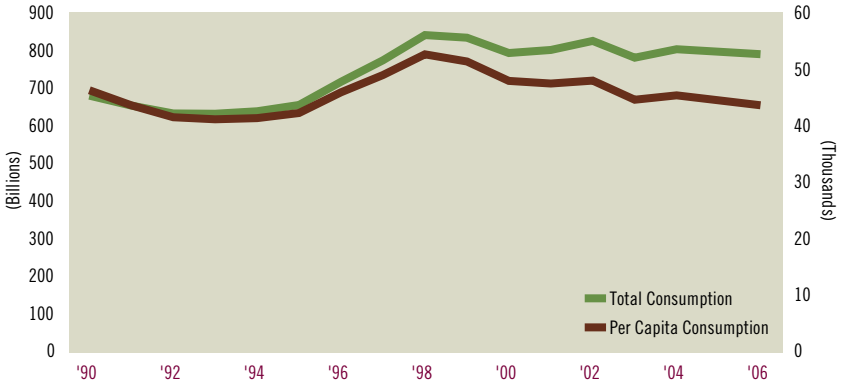
Californians consumed about 6 million cubic feet per day (MMcfd) of natural gas in 2006, half of which were used in electric generation. Only 15 percent of the total natural gas consumption was produced in California. The remaining was imported from the Southwest (38 percent) and Rockies (24 percent) in the U.S. and from Canada (23 percent).

For natural gas use, the SCAG region is served by the Southern California Gas Company. A small portion of the region is served by a municipal gas utility, Long Beach Energy (part of the City of Long Beach). In 2006, the SCAG region consumed about 791 billion cubic feet of the natural gas excluding electricity generation use. Since 2000, the total non-electric generation use of natural gas in the region has been fluctuating slightly around 800-billion cubic feet level and is projected to remain relatively constant for the next ten years. As to the per capita consumption of natural gas in the region, it has been on a gradually de-

clining path since the peak of 53,000 cubic feet in 1998 reaching about 44,000 cubic feet in 2006 (Figure 99).

Figure 99

Natural Gas Consumption*
(Cubic Feet)



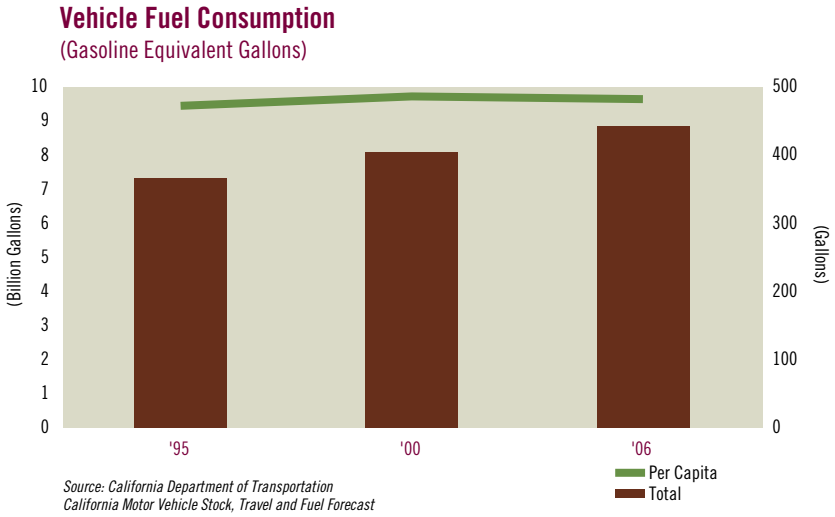
** Excluding the use for electricity generation*
Source: California Energy Commission

Vehicle Fuel Consumption

In 2006, more than 40 percent of the crude oil to California refineries came from foreign imports, exceeding for the second consecutive year the production from California (37 percent). The share of foreign imports has been increasing rapidly from below 10 percent in 1995 to over 40 percent in 2006. During the same period, production from California decreased from 50 percent to below 40 percent while imports from Alaska also decreased from 41 percent to 20 percent. Nationally, the U.S. became a net oil importer in 1970 and oil imports currently account for about 65 percent of the total consumption. In 2005, imports of fossil fuels was about $250 billion, responsible for 35 percent of the national trade deficit ($716 billion).[17]

In 2006, the region consumed about 8.9 billion gallons of vehicle fuels, an increase of about 22 percent from 1995 (Figure 100). However, per capita vehicle fuel consumption, though increasing slightly between 1995 and 2000 from 472 to 485 (gasoline equivalent) gallons, declined slightly to 481 (gasoline equivalent) gallons in 2006.

Figure 100



Impacts on Global Warming

The combustion of fossil fuels (petroleum, natural gas and coal) to release their energy creates carbon dioxide emissions (CO2), the most significant greenhouse gas (GHG) that affects global climate change and specifically global warming. This is in addition to fossil fuels' impacts on regional air quality including $PM_{2.5}$ and ozone pollution as described in the Air Quality Section. For example, burning of fossil fuels for mobile sources in the region is responsible for more than 85 percent of total NO_X emissions, a precursor of ozone pollution.

Climate change is the shift in the "average weather" that a given region experiences. Currently, the Earth is warming faster than at any time in the previous 1,000 years and eleven of the last 12 years (1995-2006) with the exception of 1995 ranked among the 12 warmest years on record since 1850. The global mean surface temperature has increased by 1.3^0F for the past century. Human activities are altering the chemical composition of the Earth's atmosphere through the release and build up of global greenhouse gas (GHG) emissions, predominantly (77 percent) CO_2, that absorb the heat. Global atmospheric GHG concentrations have increased markedly since 1750 and now far exceed pre-industrial values. Between 1970 and 2004, the GHG_{18} emissions grew 70 percent from 28.7 to 49 Gigatonnes of CO_2 equivalent.

Global warming poses a serious threat to the economic well-being, public health and natural environment in Southern California and beyond. The potential adverse impacts of global warming include, among others, a reduction in the quantity and quality of water supply, a rise in sea levels, damage to marine and other ecosystems, and an increase in the incidences of infectious diseases.

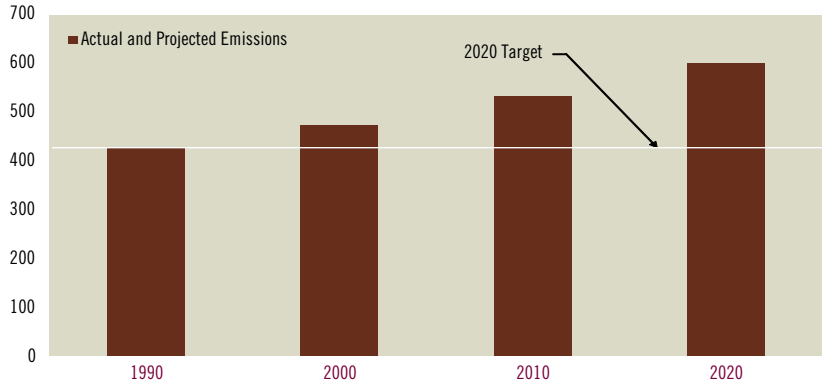
In 1990, California generated 426 million metric tons of CO_2 equivalent GHG emissions that increased to reach 473 million metric tons in 2000 and 493 million metric tons in 2004. It is projected to further increase to 600 million metric tons by 2020 (Figure 101). This California GHG emissions inventory excludes all international fuel uses, reporting them separately. Including these international emissions would

increase total emissions by 27 to 40 million metric tons of carbon dioxide–equivalent GHG emissions, depending on the year. CO_2 emissions generally track closely with trends in energy use, adjusting for changes in fuel mix and the relative carbon intensity of the various fuels.

When compared to the rest of the nation, as noted before, California has a relatively more energy-efficient economy. In addition, California economy's energy consumption is also less carbon-intense. For example, California has relied much less on coal and more on natural gas than the rest of the nation. Coal is generally more harmful to the environment than natural gas due to the mercury, greater criteria pollutants (sulfur dioxides, etc) and greenhouse gases emitted. California's choices have helped reduce carbon dioxide emissions. *Hence, in 2004, per capita GHG emissions in California (13.7 metric tons) were significantly lower than in the rest of the nation (24.5 metric tons) (Figure 102). Among all states in the nation, California ranked 3rd lowest in per capita CO_2 emissions, following Vermont and New York.*

Figure 101

California Climate Change Emission Baseline
Million Metric Tons (CO_2 Equivalent)



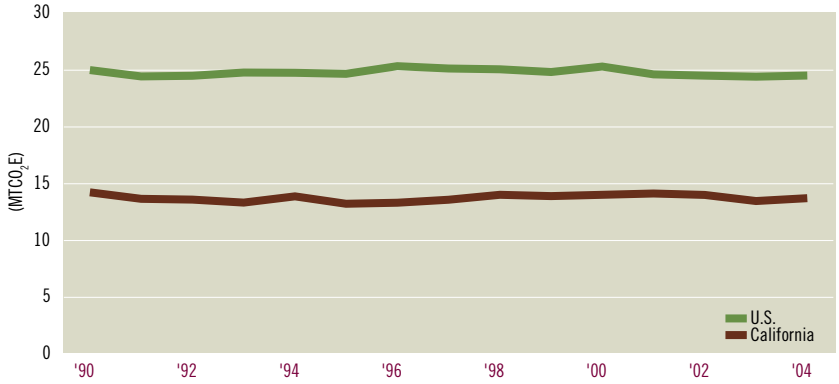
Source: California Climate Action Team Report, March 2006

California is the most populous state with the largest state economy in the nation. Despite of its achievement in energy efficiency and less carbon intensive energy use, California is second only to Texas in the nation in term of total CO_2 emissions, and is the 16th largest source of climate change emissions in the world, exceeding most nations. The SCAG region, with close to half of the state's population and economic activities, is a major contributor to the global warming problem and should also be a major contributor to its solution.

In 2006, state legislation Assembly Bill No. 32 (AB 32), the California Global Warming Solutions Act, passed into law requiring that by 2020 the statewide greenhouse gas emissions be reduced to the 1990 level. This would represent a total reduction of 174 million metric tons of (CO_2 equivalent) emissions.

Figure 102

Per Capita Greenhouse Gas Emissions
(Metric Tons of Carbon Dioxide Equivalents, $MTCO_2E$)



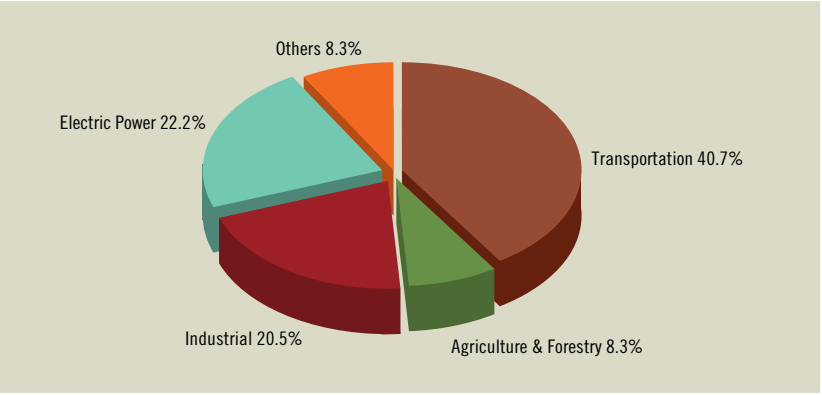
Source: California Energy Commission, U.S. Environmental Protection Agency, and Bureau of Economic Analysis

Among the climate change pollutants resulting from California's economic activities, 81 percent are CO_2 emissions from fossil fuel combustion. In addition, non-fossil fuel sources produced 2.8 percent of

the total pollutants mainly due to cement production. Methane (CH_4) accounted for 5.7 percent of the total pollutants generated primarily from landfills, enteric fermentation and manure management. Nitrous Oxide (N_2O) accounted for another 6.8 percent largely due to mobile source combustion and agricultural soil management. Finally, other gases with high global warming potentials (GWP) accounted for the remaining 2.9 percent. These high GWP gases include use of substitutions of other gases (hydrofluorocarbons or HFCs) for ozone-depleting gases, electricity transmission and distribution (Sulfur Hexafluoride or SF_6), and semiconductor manufacturing (perfluorocarbons or PFCs and SF_6). It should be noted that the percentages of climate change pollutants associated with each gas were generally stable over the 1990 to 2004 period. However, high GWP gas percentages are rising somewhat.

Figure 103

Sources of California's Greenhouse Gas Emissions, 2004



** Includes electricity imports and excludes international bunker fuels*
Source: California Energy Commission

Among the different sectors in California, transportation is the largest source (40.7 percent) of climate change emissions followed by electricity production (22.2 percent) from both in-state and out-of-state sources (Figure 103). Electricity imported to California and the SCAG region from the Southwest has a significant percentage that is coal-based generation which has higher carbon intensity than in-state generation. The industrial sector was the third largest source at 20.5 percent.[19] The SCAG region is likely to have a similar pattern as the state.

Figure 104

AB 32 Implementation - Air Resources Board

2007-01-01	ARB maintains statewide inventory
2007-06-30	List of discrete early actions
2008-01-01	Regulation for mandatory reporting of Emissions Adopt 1990 baseline/2020 target
2009-01-01	Scoping plan of reduction strategies
2010-01-01	Regulations to implement early actions
2011-01-01	Regulations to implement scoping plan

Source: California Air Resources Board

The overall schedule to implement AB 32 is shown in Figure 104. On June 21, 2007, the California ARB approved three discrete early actions measures which can be adopted as regulations and made enforceable no later than January 1, 2010. These discrete early action measures would reduce at least 13 million metric tons (CO_2 equivalent) emissions, about 7 percent of the total reductions needed by the 2020.

The discrete early action measures include the following:

1. **The Governor's Low Carbon Fuel Standard,**
2. **Increase methane capture from existing landfill, and,**
3. **Restrict the use of high global warming potential refrigerant for motor vehicle air conditioning.**

The Low Carbon Fuel Standard goal is to reduce the carbon intensity of California's passenger vehicle fuels by at least ten percent by 2020, cutting CO_2 equivalent greenhouse gas emissions by 10 to 20 million metric tons. Potential low carbon fuels include biodiesel, hydrogen, electricity, compressed natural gas, liquefied petroleum gas and biofuels. Transportation accounts for over 40 percent of the greenhouse gas emissions in California. Therefore, reductions of emissions from this source are vital. This is the single biggest stand-alone measure after the motor vehicle greenhouse gas standards the ARB has already adopted.

Methane generated by landfills, unless captured first by a gas recovery system, is emitted to the atmosphere and becomes a potent climate change emission. Currently, federal regulations require emission controls for larger landfills. However, there are no consistent statewide standards for smaller and other uncontrolled landfills. Approximately 40 landfills are identified by the Integrated Waste Management Board as not having emissions controls. The requirement for installing emission control systems at smaller and uncontrolled landfills, and the improvement of collection efficiencies at controlled landfills would result in total reductions on the order of two to four million metric tons by 2020.

Hydrofluorocarbons or HFCs are a class of compound with high global warming potential of 1,300 relative to CO_2. Major applications of HFCs include refrigeration and air conditioning. Complete ban of HFC-134a due to its climate change impacts was instituted in Europe recently.

In October 2007, ARB approved additional discrete early action measures to reduce greenhouse gases from the trucking industry, greener ports, cement and smeiconductor industries and consumer products. The new measures are projected to reduce about 3 million metric tons (CO_2 equivalent) of annual greenhouse emissions.

In addition to the discrete early action measures mentioned above, ARB also approved 35 additional emission reduction measures to reduce another 26 million metric tons (CO_2 equivalent) emissions by 2020. This group includes strategies such as cooler automobile paints, and forestry protocol that could be developed relatively quickly.

Reducing diesel PM as part of the State Implementation Plan (SIP) will also help meet the climate protection goals. Notably, the implementation of the one billion dollar bond to reduce goods movement-related emission is another key part of the diesel clean up strategy. The SIP, along with the AB 1493 vehicle climate change standards, will contribute additional reductions of 30 $MMTCO_2$.

Finally, the ARB is also in the process of developing a comprehensive Scoping Plan due in late 2008, which will outline a multifaceted approach to meet the 2020 reduction target defined by AB 32.